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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

BLUM, DAVID S

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 10/04/2002

6

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/945,535

Applicant(s)

AHN ET AL.

Examiner

David S Blum

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 September 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-37 and 51-56 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-37 and 51-56 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The corrected or substitute drawings were received on 9/11/02. These drawings are acceptable.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1-37, and 51-54 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The insertion of "using a substantially thermal process" into the independent claims 1, 9, 14, 22, 30, and 51 constitutes new matter.

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 1-2, 5-10, 13-15, 18-23, 26-31, 34-37, 51-52, and 54 rejected under 35 U.S.C. 112, second paragraph, as failing to set forth the subject matter which

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applicant(s) regard as their invention. Evidence that claims 1-2, 6-10, 13-15, 18-23, 26-31, 34-37, 51-52, and 54 fail(s) to correspond in scope with that which applicant(s) regard as the invention can be found in Paper No. 1 filed 8/30/01. In that paper, applicant has stated that the novel process of forming a gate oxide layer includes thermal evaporation deposition of a metal layer and more particularly electron beam evaporation of the metal (summary of the invention) , and this statement indicates that the invention is different from what is defined in the claim(s) because the independent claims (1, 9, 14, 22, 30, and 51) do not limit the invention in terms of thermal evaporation deposition method. The claims allow for any vapor deposition method.

Allowable Subject Matter

6. The indicated allowability of claims 3-4, 11-12, 16-17, 24-25, 32-33, and 53-56 is withdrawn in view of the newly discovered reference(s) to electron beam deposition. Rejections based on the newly cited reference(s) follow.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in-

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(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or
(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

8. Claims 1-2, 14-15, and 51-54 are rejected under 35 U.S.C. 102(e) as being clearly anticipated by Maiti (US006020024A).

Maiti teaches all of the positive steps of claims 1-2, 14-15, and 51-52 in that a zirconium (group IVB) layer is deposited on a transistor body region by an evaporation technique and oxidized to form an oxide layer (column 3 lines 30-52) between first and second source/drain regions (figure 3). A gate (20) is coupled to the metal oxide layer. It is understood that Maiti teaches vapor deposition of a metal oxide or sputtering (both substantially thermal processes) and oxidation of a metal layer and that the instant application teaches electron beam evaporation as an improvement to sputtering and oxidizing the metal. The claims as written are broad so that they encompass all evaporation methods and sputtering is a physical thermal evaporation deposition technique.

Regarding the process steps recited in "product by process claims" 51-54, the process steps are given little weight in product or device claims and Maiti teaches the device of claims 51-54. In re Thorpe, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 22-23, and 30-31, are rejected under 35 U.S.C. 103(a) as being unpatentable over Maiti (US006020024A) in view of admitted prior art.

Maiti teaches all of the positive steps of claims 22-23, and 30-31 except for the application of wordlines, sourcelines, bitlines and system busses. Maiti teaches a zirconium (group IVB) layer is deposited on a transistor body region by an evaporation technique and oxidized to form an oxide layer (column 3 lines 30-52) between first and second source/drain regions (figure 3). A gate (20) is coupled to the metal oxide layer. It is understood that Maiti teaches vapor deposition of a metal oxide or sputtering and oxidation of a metal layer and that the instant application teaches electron beam evaporation as an improvement to sputtering and oxidizing the metal. The claims as written are broad so that they encompass all evaporation methods and sputtering is a physical thermal evaporation deposition technique.

Maiti teaches that the device formed is a metal oxide field effect transistor with a high k metal gate for IC's. The admitted prior art (pages 1-4) teaches that these devices are

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commonly used in IC's particularly processor chips, mobile telephones, and memory devices. These devices commonly use wordlines, sourcelines, bitlines and system busses.

One skilled in the requisite art at the time of the invention would modify Maiti by completing the device and circuit to form IC's, particularly processor chips, mobile telephones, and memory (arrays) devices (which include wordlines, sourcelines, bitlines and system busses) as taught by the admitted prior art to be conventional practice .

11. Claims 5-7, 13, 18-20, 26-28, and 34-36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maiti (US006020024A) in view of the admitted prior art as applied to claims 1, 14, 30, 36, and 51 above, and further in view of Yano (US005810923A).

Maiti and the admitted prior art teach all of the positive steps of claims 5-7, 13, 18-20, 26-28, and 34-36 except for the temperature of the substrate, oxidizing in atomic oxygen, and oxidizing temperatures. Maiti is silent as to the substrate temperature and oxidizing temperature. Yano teaches electron beam evaporation of zirconium oxide at substrate temperatures of 300-700 degrees Celsius (column 10 line 5). Although Yano is depositing zirconium oxide, not zirconium as Maiti, Yano suggests reasonable temperatures for the deposition and oxidation of the metal. These ranges are considered to involve routine optimization while it has been held to be within the level of

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ordinary skill in the art. As noted in re Aller, the selection of reaction parameters such as temperature and concentration would have been obvious:

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art. Such ranges are termed "critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

In re Aller 105 USPQ233, 255 (CCPA 1955). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmischer 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).

Yano deposits the metal layer with atomic oxygen (electron beam) suggesting that Maiti could anneal in atomic oxygen rather than molecular oxygen. "the oxidizing gas used herein may be oxygen, ozone, atomic oxygen and NO₂." (column 21 lined 35-36), thus teaching an art recognized equivalence for oxygen and atomic oxygen in oxidizing zirconium.

One skilled in the requisite art at the time of the invention would have modified Maiti by substituting atomic oxygen for molecular oxygen as suggested by Yano and used any ranges or exact figures suitable to the method in the process of deposition regarding temperature using prior knowledge, experimentation, and observation with the apparatus used in order to optimize the process and produce the metal oxide layer structure desired to the parameters desired.

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12. Claims 8-10, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maiti (US006020024A) in view of Moise (US006211035B1).

Maiti teaches all of the positive steps of claims 8-10, and 21 as recited above, except for annealing the metal layer (type IVB, zirconium) in a plasma of krypton and oxygen.

Moise teaches layers of ZrO₂ can be formed either as an oxide or a metal layer that is oxidized (column 10 lines 53-57). Moise also teaches a method for oxidizing within the used equipment by using an oxygen-containing plasma along with an optional inert gas (column 8 lines 11-13), defining inert gas as helium, neon, argon, krypton, or xenon (column 12 lines 23-24).

One skilled in the requisite art at the time of the invention would modify Maiti by including krypton as the inert gas during oxidation as known to be conventional practice in the art.

13. Claims 29, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maiti (US006020024A) in view of admitted prior art and in further view of Moise (US006211035B1).

Maiti and the admitted prior art teach all of the positive steps of claims 29 and 37 as recited above except for annealing the metal layer (type IVB, zirconium) in a plasma of krypton and oxygen. Moise teaches layers of ZrO₂ can be formed either as an oxide or a metal layer that is oxidized (column 10 lines 53-57). Moise also teaches a method for

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oxidizing within the used equipment by using an oxygen-containing plasma along with an optional inert gas (column 8 lines 11-13), defining inert gas as helium, neon, argon, krypton, or xenon (column 12 lines 23-24).

One skilled in the requisite art at the time of the invention would modify Maiti and the admitted prior art by including krypton as the inert gas during oxidation as known to be conventional practice in the art.

14. Claims 3-4, 11-12, 16-17 and 55-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maiti (US006020024A) in view of Park (US 5,795,808), or Takeoka (US 4,647,947) or Thomas (US 4,920,071).

Maiti teaches all of the positive steps of claims 3-4, 11-12, 16-17 and 55-56 as recited above, except for depositing the metal layer by electron beam evaporation, including a 99.9999 pure metal target at a range of 5.16 eV to 7.8 eV.

Park deposits a zirconium film by electron beam deposition (column 4 lines 16-17) at 99.0 purity or higher (column 4 line 25). Takeoka deposits a zirconium film by electron beam deposition (column 7 lines 65-68). Thomas deposits a zirconium film by electron beam deposition (column 4 lines 55-65). All three of the above references, taken alone or collectively, teach that electron beam deposition is a well-known art recognized equivalent method to sputtering.

Regarding the limitation of forming the layer with a conduction band offset in a range of 5.16-7.8 eV, as the process steps are identical and there is no teaching as to modifying

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the process to achieve the specified range, it is considered to be a range of common use, and one skilled in the requisite art would know how to optimize the process (as recited above) to achieve the range.

It would be well within the ordinary skill in the art to substitute sputtering with e-beam deposition.

15. Claims 24-25 and 32-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maiti (US006020024A) in view of admitted prior art and in further view of Park (US 5,795,808), or Takeoka (US 4,647,947) or Thomas (US 4,920,071).

Maiti teaches all of the positive steps of claims 24-25 and 32-33 as recited above except for depositing the metal layer by electron beam evaporation, including a 99.9999 pure metal target at a range of 5.16 eV to 7.8 eV.

Park deposits a zirconium film by electron beam deposition (column 4 lines 16-17) at 99.0 purity or higher (column 4 line 25). Takeoka deposits a zirconium film by electron beam deposition (column 7 lines 65-68). Thomas deposits a zirconium film by electron beam deposition (column 4 lines 55-65). All three of the above references, taken alone or collectively, teach that electron beam deposition is a well-known art recognized equivalent method to sputtering.

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It would be well within the ordinary skill in the art to substitute sputtering with e-beam deposition.

Response to Arguments

16. Applicant's arguments filed 9/11/02 have been fully considered but they are not persuasive.

The addition of the limitation "using a substantially thermal process constitutes new matter and fails to eliminate sputtering, sputtering being a thermal process.

Yano teaches the use of atomic oxygen (cited above).

Yano depositing zirconium oxide suggests that zirconium could also be deposited. Further new references explicitly teach depositing zirconium by e-beam deposition.

Conclusion


17. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Ohring shows that sputtering is a physical vapor deposition.

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Blum whose telephone number is (703)-306-9168 and e-mail address is David.blum@USPTO.gov .

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached at (703)-306-2794. Our facsimile number for Before-Final Communications is (703)- 872-9318 and for After-Final Communications is (703)- 872-9319. The facsimile number for customer service is (703)-872-9317. Our receptionist's number is (703)-308-0956.

David S. Blum

September 25, 2002


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